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CONCRETE 'ISLAND' TOWED TO ARCTIC

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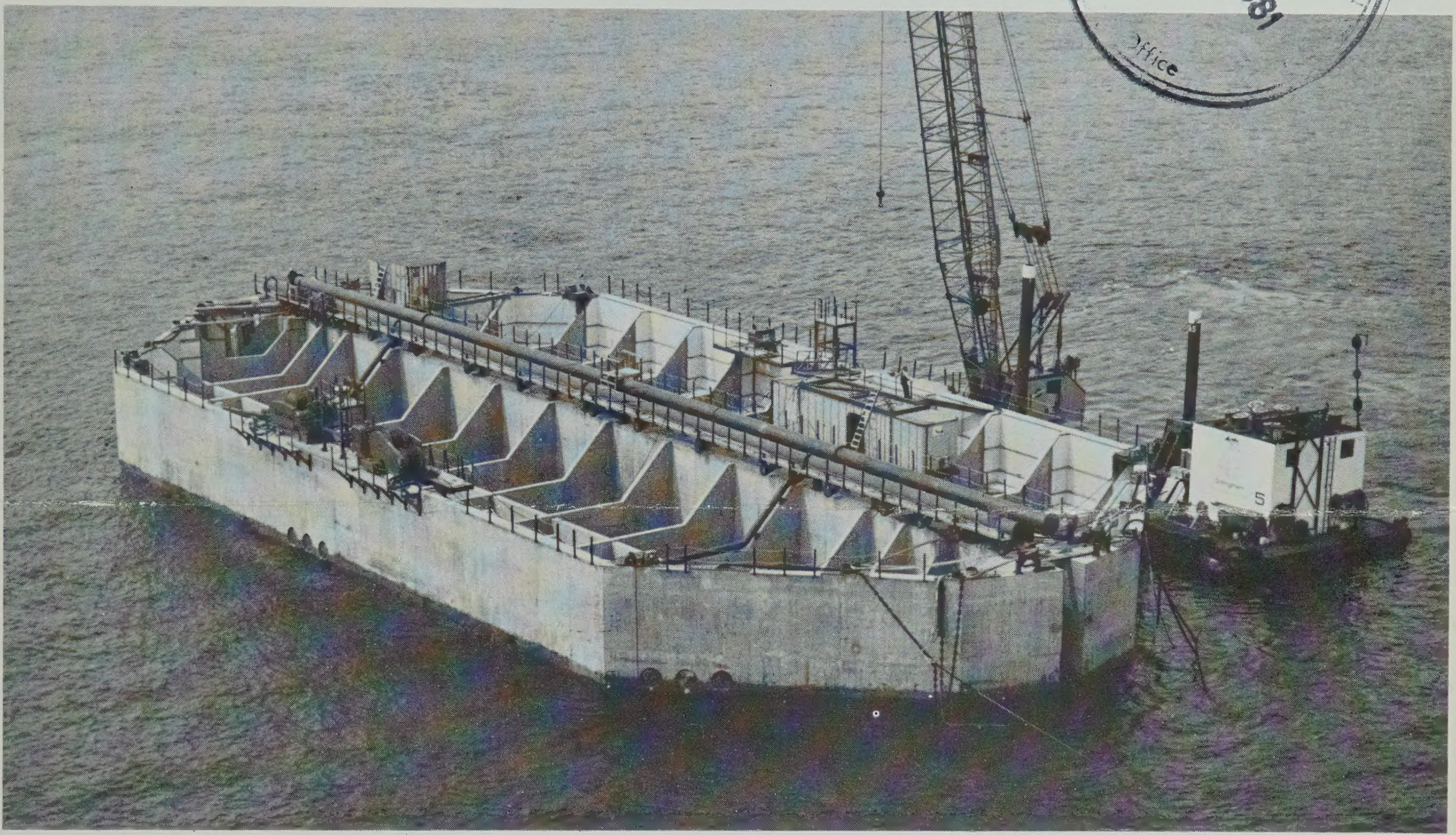

Two concrete caissons, lashed together for the long journey.

Construction projects don't usually attract national press and television coverage... but this summer, the news media came to B.C. in full force.

Four huge concrete caissons—each two-thirds the length of a football field—were towed from Vancouver Harbour... 5 500 kilometers by an 8,000 horsepower tugboat to a desolate location in the Beaufort Sea.

And—around the middle of September—these four caissons became the perimeter of a very ingenious man-made Arctic island.

Several stories are involved here—each of them worthy of a separate article in itself.

There is the reason for the island... the construction of the caissons... the complicated towing and placing procedure... as well as a follow-up story at some point in the future to find out how it all worked out.

In this issue of *Inform*, however, we'll briefly discuss two of these topics and deal mainly with the construction of the caissons.

First, the reason for the island? Fuel.

Dome Petroleum Limited of Calgary will use this island for year-round oil and gas exploration.

(The type of man-made "islands" currently used for drilling operations are formed from dredged material. They are not only very susceptible to erosion, but they also serve a one-time use, only. This concrete island is designed to be "de-dredged" of its cell-fill material and floated away to another location for re-use.)

Located in the Tarsuit area of the Beaufort Sea (about 160 km west of Tuktoyaktuk), the unique concrete caissons will also serve as a test/prototype island—to determine how well the structure stands up to the Arctic's extremely harsh conditions and incredible ice forces.

Designed by a Vancouver consulting firm (Swan Wooster Engineering Co. Ltd.), the caissons were constructed by Dillingham Corporation's North Vancouver Marine Division—with almost record-breaking speed.

Construction began three days after Dome awarded Dillingham the $12.5 million contract to build the floating concrete caissons on January 9, 1981... and the work continued 24 hours a day until the target date of June 25.

(Severe ice conditions in the Beaufort permit only a brief travel period during the summer, so the deadline was very critical. And Dillingham's specialized waterside facilities—including gantry cranes and a graving dock—made the rapid construction possible.)

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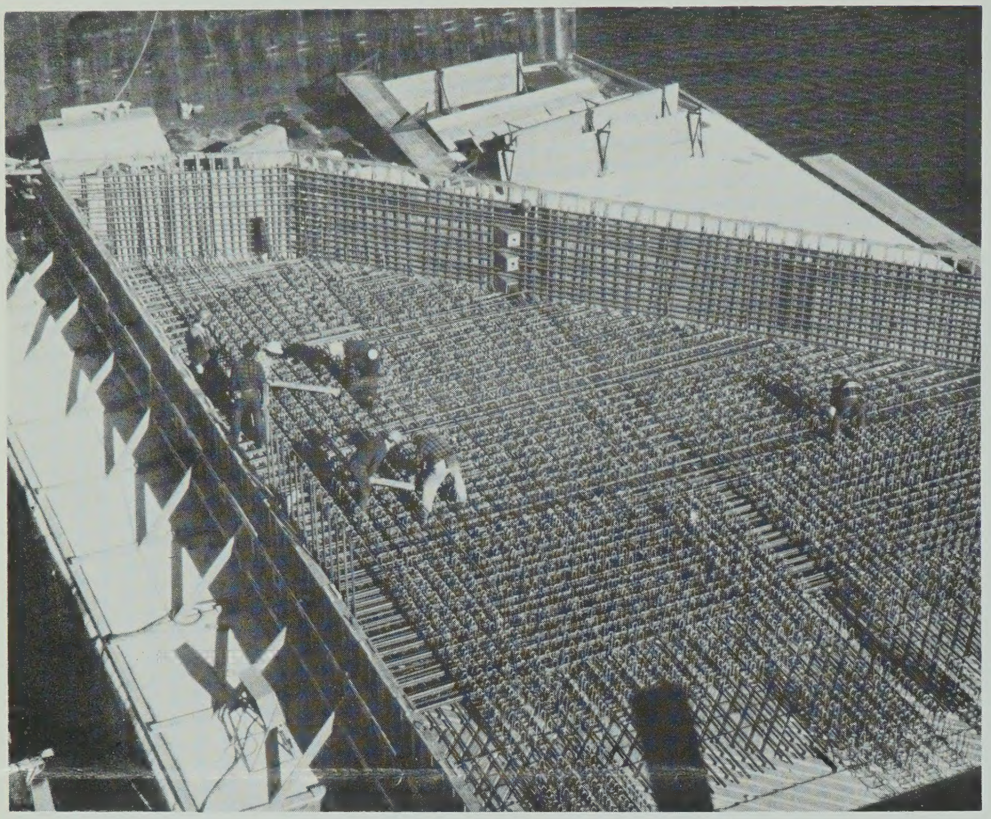

The rebar content is roughly four times that of other, similar structures…1100 tonnes for each caisson…and 4 200 tonnes of concrete was poured into each caisson!

The first consideration was the enormity of the finished concrete caissons.

Each caisson measures 11.5 metres high, 15 metres wide and 69 metres long. Each weighs 5 300 tonnes, and each has 17 cells to hold the fill material. Their size makes them some of the largest floating concrete structures ever constructed on the west coast.

A total of 8 800 cubic metres of semi-lightweight concrete was used in 80 pours—the first made on February 4 and the last on June 17.

Each caisson was bolstered with 1 100 tonnes of reinforcing steel, so it can withstand the pressures of winter ice in the Beaufort Sea. And the set was equipped with nearly 50 000 metres of wire…about 1,000 different instruments of a dozen types…and a computer system to gather data on ice loads and stresses. The data will be employed in the design of future drilling islands for ice-covered waters.

In order to meet the deadline, project manager Cyril Sookachoff ran three shifts per day. Dillingham also set up their own batch plant in the yard so the concrete could be mixed on site, and adjusted when necessary.

The large size of the caissons required a special, lightweight aggregate. Herculite (weighing 60% of normal aggregate) was imported by truckload from Calgary.

Because of the extreme forces in the Beaufort Sea, the content of rebar is about four times that of other, similar structures… and the strength of the concrete is extremely high—40 MPa.

To accommodate the high density of rebar, the use of a super plasticizer was required—so as to obtain a fluid concrete which could flow in and around the steel and yet not suffer a strength decrease due to extra water.

While one caisson was under construction in the graving dock, a second was started on a scow. When they reached a certain elevation, they were floated off the dock and off the scow, so that work could start on the other two caissons.

At the same time the caissons were under construction, a special barge was built in Japan and towed to B.C., arriving July 1. The barge (which held all four caissons) is 147.8 metres long, 32 metres wide and 8.5 metres deep.

In order to load the caissons, the barge was submerged to a crushed-rock pad, 16 metres below the water surface at high tide.

The caissons, lashed together in pairs, were floated—with the aid of six Seaspan tugboats—over the barge and lowered with the tide to the barge deck. (These manoeuvres took three days!)

Then, on the scheduled date of July 10, the barge was refloated, the load secured and the Canmar Tugger 2 connected for the tow north. At Pauline's Cove on Herschel Island, the barge was submerged again…and the caissons were floated off and towed another 100 km to the artificial island site.

While the caissons and the special barge were being constructed, another work crew was on location in the Beaufort Sea preparing the berm (a sub-sea island) with literally "millions of yards" of dredged material and gravel, reported a company spokesman.

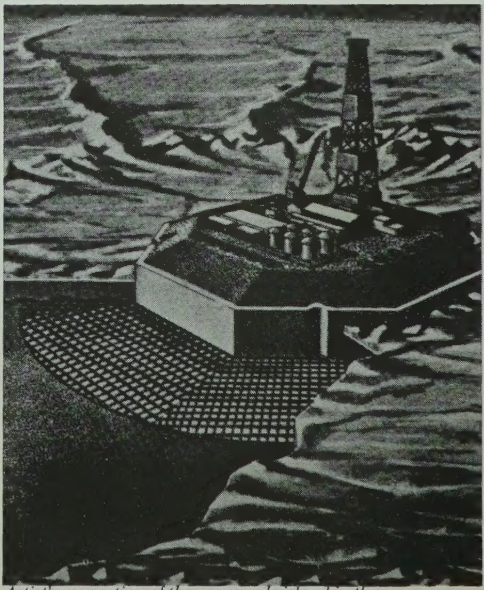
The berm is 175 metres in diameter and is dredged to within 6.5 metres of the surface… so the 11.5 metre caissons are submerged up to five metres of their height. For stability, the underside of each caisson has a ribbed effect —created by using a corrugated metal decking—allowing them to better grip the berm.

When the caissons reached their destination, they were joined together with steel gates (each weighing 40 tonnes) and all the cells were filled with sandfill.

They now form the outer perimeter of an island that has 7 000 square metres of surface for drill rig, employee housing and associated facilities for the winter drilling season.

"I just spoke with Dome this morning (September 29)," beamed the proud project manager, Cyril Sookachoff, "and everything is in place and ready to go."

The follow-up story? Let's see how these concrete caissons stand up to the Arctic this winter…and we'll report back to our *Inform* readers next spring.


Artist's conception of the man-made island in the Beaufort Sea.

Continuous testing ensures quality product

Quality control is one of, if not **the** most important aspect to consider in the production of both cement and concrete.

Quality control is what ensures that limestone, shale, clay, sand, iron ore and gypsum are combined into a consistently high quality grey dust known as portland cement.

And it's quality control that ensures the proper amounts of cement, sand, aggregate, water and admixtures will be combined to form a consistent, high quality, ready mixed concrete that will perform as specified.

Cement plants operate 24 hours a day, seven days a week—so that when the plant is running, the raw materials, raw mix, clinker and finished cement are constantly monitored, tested and reported on an hourly basis.

Continuous testing also takes place in the production of concrete—from the testing of raw materials at ready-mix plants to tests conducted at the job site.

Field checks are constantly performed to ensure that the proper specifications are met. These checks include slump tests... air content tests... and the taking of concrete cylinder test specimens.

The purpose of the slump test is to determine the consistency of the fresh concrete and to check the uniformity of concrete from batch to batch.

Concrete air tests are made to determine the amount of entrained air in the concrete mix. When exposed to either freeze/thaw or salt action, the concrete should contain 5% to 7% entrained air by volume.

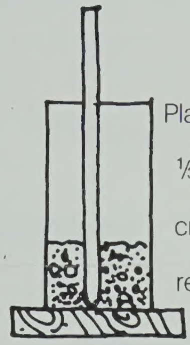
And, concrete compression tests specimens (outlined here) are made and tested for either of two reasons: (1) to check the adequacy of mix proportions for strength or as a basis for acceptance; (2) to determine when to remove forms or when a structure may be put into service.

Remember: Quality control is the invisible and essential ingredient that goes into every tonne of cement produced... and every cubic metre of concrete produced. It makes all the difference to the end result.

COMPRESSION TEST SPECIMENS

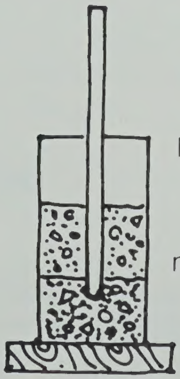
Testing should be done at least once a day, but not less than one test for each 150 cubic metres of concrete. It is recommended that at least one cylinder be cast for breaking at seven days, and two for breaking at 28 days.

1



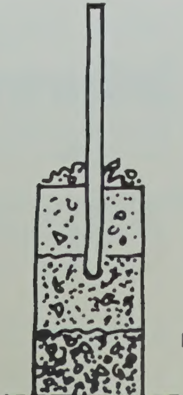
Place the cylinder mould on a rigid surface. Fill it ⅓ full and rod 25 times. (For low slump concrete requiring vibration for consolidation, refer to CSA-A23.2-3C.)

2



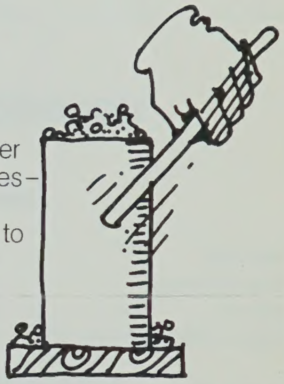
Fill again with a second layer until ⅔ full. Rod 25 times, with the rod penetrating into, but not through, the first layer.

3



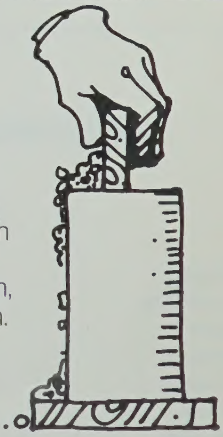
Overfill the cylinder slightly and rod the top layer 25 times. As before, the rod should penetrate into, but not through, the second layer.

4



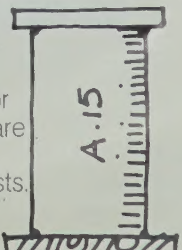
Next, tap cylinder lightly on all sides—to remove entrapped air and to close voids left by rodding.

5



Screed off excess concrete and finish the top with a straight-edge; then, trowel until smooth.

6 Mark the cylinder with an identification number...secure the cylinder cover on top...and carefully place the cylinder in a curing box—where it will not be subjected to movement or vibration, and where a temperature range of 15–25°C can be maintained. Allow cylinders to sit for 24 hours before they are transferred to curing storage for strength tests.



CONSTRUCTION ACTIVITY IN WESTERN CANADA.

CONTRACT AWARDS ($Thousands)

	Year-toDate August, 1981	 August, 1980	Change $	 %
Building Construction				
Manitoba	211,966	213,460	(1,494)	(1)
Saskatchewan	344,751	295,208	49,543	17
Alberta	2,515,665	2,249,925	265,740	12
British Columbia	2,269,050	1,806,751	462,299	26
Engineering Construction				
Manitoba	104,269	76,559	27,710	36
Saskatchewan	285,379	78,362	207,017	263
Alberta	3,015,856	875,483	2,140,373	244
British Columbia	596,351	403,571	192,780	48

Source: CanaData Division, Southam Business Publications Limited

HOUSING STARTS (Units)

	Year to Date Sept. 1981	 Sept. 1980	Change Units	 %
Manitoba	1,958	1,258	700	56
Saskatchewan	3,186	2,862	324	11
Alberta	24,529	18,309	6,220	34
British Columbia (urban only)	24,403	21,635	2,768	13

Source: Central Mortgage and Housing Corporation

BUILDING PERMITS ($Millions)

	Year-to-Date Sept., 1981	 Sept. 1980	Change $	 %
Winnipeg	225.2	182.5	42.7	23
Thunder Bay	36.2	22.8	13.4	58
Regina	157.2	82.6	74.6	90
Saskatoon	137.2	169.6	(32.4)	(19)
Edmonton	822.4	629.9	192.5	30
Calgary	1,612.2	1,049.5	562.7	53
Vancouver	454.7	337.8	116.9	34

Source: Municipal Governments and Statistics Canada 64-001

OILWELL COMPLETIONS (Units)

	Year-to-Date Oct. 3, 1981	 Oct. 4, 1980	Change Wells	 %
Alberta	4,450	5,266	(816)	(15)
Saskatchewan	686	1,043	(357)	(34)
British Columbia	180	326	(146)	(45)
Northern Canada	8	16	(8)	(50)

Source: Oilweek, Maclean-Hunter Limited

PROVINCIAL REVIEW

Month of August, 1981 vs. August, 1980

ALBERTA

Contract Awards - down 55%

SASKATCHEWAN

Contract Awards up 55%

MANITOBA

Contract Awards - up 39%

BRITISH COLUMBIA

Contract Awards - down 7%

CONSTRUCTION PRICE INDEX (1971 = 100)

	Aug., 1981	Aug. 1980	% Change
Residential	250.4	226.4	10.6
Non Residential	260.0	238.1	9.0
Union Wage Rates	273.3	252.9	8.0

MONEY MARKET RATES (%)

	Oct., 1981	Oct. 1980
Canadian Chartered Banks Prime	20.00	12.75
Conventional Mortgages	19.75	14.87

Source: Statistics Canada — CanSim

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Any comments, suggestions or ideas regarding this publication are always welcome.

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